



## Career Cluster Resources for Science, Technology, Engineering and Mathematics



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## **Introduction**

### **The States' Career Cluster Initiative**

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The U.S. Department of Education Office of Vocational and Adult Education (OVAE) has identified 16 career clusters representing career opportunities for the 21<sup>st</sup> century economy. These clusters will frame student opportunities as they pursue postsecondary education and a wide range of career opportunities from front-line to professional and managerial careers.

Helping students make their dreams become a reality was the driving force behind the nation's Career Clusters initiative launched June 1, 2001. Twelve lead states and the District of Columbia were partners in the development of the tools supporting eleven career clusters which, when combined with the five clusters that have already been developed, will represent all career possibilities.

The National Association of State Directors for Career and Technical Education Consortium (NASDCTEc) and their Board of Directors assumed leadership for coordinating the project. This in itself was unique for a project of this scope. The Board and the State Directors organization believed that this initiative was of such potential impact on the Career Technical delivery system in the country that they needed to play this leadership role in the project, assuring that the materials had utility in their states once completed. Therefore, the NASDCTEc in conjunction with the State of Oklahoma (the project fiscal agent) prepared and submitted a proposal to OVAE in January of 2001. This proposal was funded at a \$2.2 million dollar level, with expectations of a second year of funding of \$2.5 million. The plan to develop eleven curriculum frameworks was very aggressive, given that each of the prior projects, designed to develop and pilot test materials for a single cluster, had received in excess of \$1 million dollars for their multiyear development work.

The project was designed to establish curriculum frameworks and supportive materials for each cluster, with a broad-based advisory committee for each cluster, led by a state. There was also a National Advisory Committee consisting of members from each of the cluster committees, along with other stakeholders. The National and State Cluster advisory committees were responsible for identifying the frameworks, pathway and foundation knowledge and skills, and other supportive

materials. The committees included representatives from states, schools, education and training, business and industry, associations, and others directly impacted by the materials.

The development of materials for each of the eleven clusters was led by a different state, with business and industry at the helm. The lead states included: Idaho and Iowa (jointly leading the Agriculture, Food and Natural Resources cluster), Pennsylvania (Architecture and Construction), Ohio (Marketing, Sales and Service), North Dakota (Finance), West Virginia (Hospitality and Tourism), South Carolina (Business, Management and Administration), Kentucky (Human Services), Arkansas (Law, Public Safety and Security), North Carolina (Science, Technology, Engineering and Mathematics), Michigan (Education and Training), and Oklahoma and the District of Columbia/Washington D.C. (jointly leading the Government and Public Administration cluster).

The five additional career clusters included Health Science led by the State of Utah, Manufacturing led by the State of Indiana, Arts, Audio Video Technology and Communications led by the V-TECS Consortium, Information Technology led by the Educational Development Center, Inc., and Transportation, Distribution and Logistics Cluster led by the State of Illinois. These clusters plan to complete their work by June 30 of 2003.

To facilitate and coordinate the developmental work of the Cluster Initiative, staff was identified and housed at the Oklahoma Department of Career and Technical Education. The staff consisted of four Cluster Coordinators: Marsha Daves, Greg Dewald, Curtis Shumaker, and Pam Stacey. Additionally, Denise Christy provided research and web development support, Lisa Batchelder provided financial support, and Karan Smith provided administrative support.

Development work for the States' Career Clusters Initiative began June 1, 2001, and the first meeting of lead states, OVAE staff, and cluster staff was held in Oklahoma City in mid-June. At this meeting, project objectives, general direction, timelines, and the initial research goals were identified. This work continued through the fall and winter of 2001 and included the identification of cluster advisory committee members, the development of cluster frameworks based on the prototype cluster models provided by V-TECS, and the identification of occupations and draft pathways along with degrees and certificates associated with the career specialties/occupations in each of the clusters.

In January of 2002, the lead state teams were brought together in Phoenix to begin the process of developing knowledge and skill statements for each of the cluster pathways and foundations. Contracted writers and lead state cluster advisory committee members, depending upon

the decisions of cluster leadership, carried out this work. A part-time editor in Oklahoma provided consistency across the cluster knowledge and skill statements. One concern that was addressed early in the process was the need for a “common look and feel” across the clusters. Ultimately, this was accomplished not only for the eleven clusters in the States’ Career Clusters Initiative, but also through close cooperative relationships between the projects, all the cluster knowledge and skill statements were developed (or retro-fitted) using the same format. This format includes a knowledge/skill statement with associated performance elements and measurement criteria. This format provides the tools needed for curriculum and assessment developers as they take the materials to the classroom.

The National Advisory Committee met in March of 2002, and reviewed the curriculum frameworks, credentials list, and lead state advisory committee memberships and structures, and forwarded those materials to the Executive Committee for the Project. The Executive Committee, made up of the Board of the NASDCTEc, also met in March, approved the materials and discussed the future actions needed to assure implementation of the cluster materials.

Originally, the project was designed for a minimum of two years and was to include the identification of 110 pilot test sites across the country, along with the development of assessments and certifications for the clusters. The Office of Vocational and Adult Education, however, determined in November of 2001 that the goals of the project were “too broad”, and terminated the project as of September 30, 2002.

Development of the products needed for curriculum and assessment was fast-tracked, with the knowledge and skill statements, performance elements and measurement criteria ready for validation by July 15, 2002. This was the result of a major effort of lead state advisory committees and staff responding to the shortened timeline and the need for quality product.

Given the efforts of the developmental teams, cluster advisory committee members were able to review and validate the knowledge and skills and supporting elements. Additionally, a national web-based validation was conducted from July 15 to August 15, 2002. All 50 states were invited to a dissemination meeting held in Charleston, South Carolina Sept 13, 2002, where the materials were distributed to participants for their use in updating their curriculum.

For further information on the status of the materials, go to the web-site, <http://www.careerclusters.org/>.

## **Section I – Pathway Model**



**Planning, managing, and providing scientific research and professional and technical services (e.g., physical science, social science, engineering) including laboratory and testing services, and research and development services.**

Sample Career Specialties / Occupations	Aerospace Engineer* Aeronautical Engineer* Agricultural Engineer* Agricultural Technician* Application Engineer* Architectural Engineer* Automotive Engineer* Biomedical Engineer* Biotechnology Engineer* Chemical Engineer* Civil Engineer* Communications Engineer* Computer Engineer* Computer Hardware Engineer* Computer Programmer* Computer Science Technician* Computer Software Engineer* Construction Engineer* Consultant* Development Engineer* Drafter* Electrical Engineer* Electrician* Electronics Technician* Energy Transmission Engineer* Environmental Engineer* Facilities Technician* Fire Protection Engineer* Geothermal Engineer* Hazardous Waste Engineer* Hazardous Waste Technician* Human Factors Engineer * Industrial Engineer* Industrial Engineering Technician* Licensing Engineer* Manufacturing Engineer* Manufacturing Technician* Manufacturing Processes Engineer* Marine Engineer* Materials Engineer* Materials Lab & Supply Technician* Mechanical Engineer* Metallurgic Engineer* Mining Engineer* Naval Engineer* Network Technician* Nuclear Engineer* Ocean Engineer* Operations Research Engineer* Packaging Engineer* Packaging Technician* Petroleum Engineer* Pharmaceutical Engineer* Plastics Engineer* Power Systems Engineer* Product Design Engineer* Project Engineer* Project manager* Prototype Engineer* Quality Engineer* Quality Technician* Radio/TV Broadcast Technician* Radiology Engineer* Researcher* Safety Engineer* Software Engineer* Sound Technician* Structural Engineer* Survey Technician* Systems Design Engineer* Technical Sales Manager* Technical Writer* Telecommunications Engineer* Textile Engineer* Transportation Engineer*	Analytical Chemist* Anthropologist* Applied mathematician* Archeologist* Astronomer* Astrophysicist* Atmospheric scientist* Biologist* Botanist* CAD operator* Cartographer* Chemist* Communications technologist* Conservation scientist* Cosmologist* Cryptographer* Crystallographer* Demographer* Dye chemist* Ecologist* Economist* Electronmicroscopist * Environmental scientist* Expert systems scientist* Geneticist* Geologist* Geophysicist* Geoscientist* Herpetologist* Hydrologist* Ichthyologist* Inorganic chemist* Laboratory Technician * Mammalogist* Marine scientist* Materials analyst* Materials scientist* Mathematician * Mathematics* Metallurgist* Meteorologist* Microbial Physiologist* Mycologist* Nanobiologist* Nuclear chemists* Nuclear technician* Numerical analyst* Nutritionist* Oceanographer* Organic chemist* Ornithologist* Paleontologist* Physicist* Polymer scientist* Programmer* Protein scientist* Protozoologist* Quality-control scientist* Radio chemist* Research chemist* Research Technician* Science Teacher * Lab Technician* Scientific visualization / graphics expert* Spectroscopist* Statistician* Technical writer* Technologist* Toxicologist* Zoologist*
Pathways	<p style="text-align: center;"><b>Engineering and Technology</b></p>	<p style="text-align: center;"><b>Science and Math</b></p>
Cluster K&S	<p style="text-align: center;"><b>Cluster knowledge and skills</b></p> <p style="text-align: center;">♦ Academic Foundations ♦ Communications ♦ Problem Solving and Critical Thinking ♦ Information Technology Applications ♦ Systems  ♦ Safety, Health and Environment ♦ Leadership and Teamwork ♦ Ethics and Legal Responsibilities  ♦ Employability and Career Development ♦ Technical Skills</p>	



## **Section II – Cluster Knowledge and Skills**



## Cluster Knowledge and Skill Statement

### Communications

**Statement:** *Demonstrate effective oral, written, and visual communication.*

**Performance Element:** Discuss effective methods to communicate essential concepts to diverse audiences.

- Measurement Criteria:** *Write and report subjective and objective information.*
- Measurement Criteria:** *Write and report information with the intent of being persuasive.*
- Measurement Criteria:** *Write and report information with the intent of being informational.*
- Measurement Criteria:** *Write and report information with the intent of being instructional.*
- Measurement Criteria:** *Analyze the audience and presentation environment.*
- Measurement Criteria:** *Explain technical concepts to non-technical audiences*
- Measurement Criteria:** *Use professional terminology.*
- Measurement Criteria:** *Identify, select, use appropriate multimedia resources.*
- Measurement Criteria:** *Apply active listening skills using reflection, restatement, questioning, and clarification.*
- Measurement Criteria:** *Discern between various communication techniques and their ability to convey various types of information.*

**Performance Element:** Effectively communicate scientific, technological, engineering, or mathematical information to the intended audience.

- Measurement Criteria:** *Prepare scientific, technological, engineering, or mathematical reports oral presentation skills.*
- Measurement Criteria:** *Prepare scientific, technological, engineering, or mathematical reports written presentation skills.*
- Measurement Criteria:** *Prepare scientific, technological, engineering, or mathematical reports visual presentation skills.*
- Measurement Criteria:** *Prepare scientific, technological, engineering, or mathematical reports oral presentation skills.*
- Measurement Criteria:** *Prepare scientific, technological, engineering, or mathematical reports multimedia presentation skills.*
- Measurement Criteria:** *Explain the various methods of giving and obtaining information.*

**Performance Element:** Read, interpret, and analyze technical materials, discerning information and concepts.

- Measurement Criteria:** *Use appropriate note-taking methods.*
- Measurement Criteria:** *Write and/or present a report on technical literature; use graphical tools as appropriate.*
- Measurement Criteria:** *Discriminate between fact and opinion.*
- Measurement Criteria:** *Seek clarity of communication by rephrasing, questioning and summarizing.*
- Measurement Criteria:** *Validate understanding and provide and or obtain constructive feedback.*

## Cluster Knowledge and Skill Statement

### Information Technology Applications

**Statement:** *Use information technology to gather, store, apply and communicate data.*

**Performance Element:** Use information technology as it supports the gathering, storage, and transfer of data and information.

**Measurement Criteria:** *Apply different techniques for gathering storing and transferring data.*

**Measurement Criteria:** *Select and use the tools to analyze and synthesize data.*

**Measurement Criteria:** *Describe the meaning of probability and how it applies to a set of data.*

**Performance Element:** Select and use different forms of information technology.

**Measurement Criteria:** *Use computer to conduct research.*

**Measurement Criteria:** *Write a report based on Internet research, using calculations, graphs, and/or spreadsheets.*

**Measurement Criteria:** *Use simulation, modeling, prototype techniques to solve problems.*

**Measurement Criteria:** *Create, organize, manage, and distribute electronic information.*

**Performance Element:** Apply technology to visualize a problem.

**Measurement Criteria:** *Select the proper visualization tools.*

**Measurement Criteria:** *Communicate data visually.*

**Statement:** *Evaluate the different technological tools used to manipulate and model data.*

**Performance Element:** Use information technology tools to manipulate and create information from data.

**Measurement Criteria:** *Use statistical tools to analyze data.*

**Measurement Criteria:** *Query and extract information from data.*

**Measurement Criteria:** *Create knowledge from data.*

**Performance Element:** Use modeling, simulation, and visualization to efficiently analyze, synthesize and communicate information.

**Measurement Criteria:** *Apply techniques for modeling systems or problems.*

**Measurement Criteria:** *Apply techniques for scientific visualization and animation of complex physical systems or problems.*

**Measurement Criteria:** *Test different scenarios to multiple variables.*

**Performance Element:** Apply current computer programming languages.

**Measurement Criteria:** *Write and execute a simple program. i.e. Basic, Java, C++.*

**Performance Element:** Use statistical tools to show reliability of data.

**Measurement Criteria:** *Using a selected statistical tool, compute data reliability.*

## Cluster Knowledge and Skill Statement

### Safety, Health, and Environmental

**Statement:** *Apply safety practices in your environment.*

**Performance Element:** Develop good safety and health practices.

**Measurement Criteria:** *Exercise good safety practices.*

**Measurement Criteria:** *Follow various regulatory codes, such as EPA, FEMA, UL, OSHA, CSA.*

**Measurement Criteria:** *Reference and use material safety data sheets.(MSDS).*

**Measurement Criteria:** *Encourage others to employ safe practices.*

**Performance Element:** Use appropriate safety techniques, equipment, and procedures.

**Measurement Criteria:** *Develop and implement emergency plans.*

**Measurement Criteria:** *Develop and implement workplace lab safety plan.*

**Measurement Criteria:** *Follow workplace regulations and record-keeping requirements.*

**Measurement Criteria:** *Use safety equipment in the workplace.*

**Measurement Criteria:** *Use eyewash and safety showers*

**Measurement Criteria:** *Accurately interpret safety signs, symbols, and labels.*

**Measurement Criteria:** *Demonstrate basic first aid.*

**Measurement Criteria:** *Use tools and equipment safely.*

**Statement:** *Develop a broad awareness of safety, health, and environmental hazards.*

**Performance Element:** Identify existing and potential hazards to safety, health, and environment.

**Measurement Criteria:** *Describe potential safety, health and environmental hazards in various situations.*

**Measurement Criteria:** *Identify physical, chemical, toxicological, biological, and radioactive hazards.*

**Statement:** *Engage in continuous improvement of environmental, health and safety practices.*

**Performance Element:** Provide feedback and analysis to those in charge of environmental, health and safety practices.

**Measurement Criteria:** *Analyze environmental impacts.*

**Measurement Criteria:** *Conduct a safety audit.*

**Measurement Criteria:** *Assess the impact of unsafe practices.*

**Measurement Criteria:** *Apply appropriate corrective action.*

**Measurement Criteria:** *Develop new safety practices and procedures for new and existing technology.*

## Cluster Knowledge and Skill Statement

### Leadership and Teamwork

**Statement:** *Participate effectively on a team.*

**Performance Element:** **Work effectively with others from diverse backgrounds.**

**Measurement Criteria:** *Identify the challenge of barriers when working on a diverse team.*

**Measurement Criteria:** *Work effectively with multi-disciplinary teams.*

**Measurement Criteria:** *Develop consensus for best outcome.*

**Performance Element:** **Exercise the ability to lead or follow in a team environment.**

**Measurement Criteria:** *Describe leadership skills necessary to bring a team to consensus on a new method of working.*

**Measurement Criteria:** *Appropriately give/take credit and responsibility.*

**Measurement Criteria:** *Divide tasks among a team of three, with no designated leader.*

**Measurement Criteria:** *Demonstrate various management skills (i.e., strategies, collaborative, resourcefulness, flexibility) and decision-making models.*

**Measurement Criteria:** *Communicate effectively verbally and non-verbally with team colleagues.*

**Measurement Criteria:** *Exhibit a strong sense of team identity and commitment to purpose*

**Measurement Criteria:** *Act responsibly as a team member, completing assigned tasks in a timely and effective manner.*

**Measurement Criteria:** *Respond to critical situations appropriately as a member of a team.*

**Measurement Criteria:** *Delegate tasks, responsibility and authority as appropriate.*

**Measurement Criteria:** *Follow up on tasks delegated to others.*

**Measurement Criteria:** *Recognize and reward individual and team contributions.*

**Measurement Criteria:** *Collaborate with others to formulate team objectives.*

**Statement:** *Understand how and when to form teams.*

**Performance Element:** **Exercise leadership and teamwork skills.**

**Measurement Criteria:** *Analyze the need for a team.*

**Measurement Criteria:** *Identify roles of team members.*

**Measurement Criteria:** *Recognize individual abilities and the importance of forming teams with others whose abilities are complementary.*

**Measurement Criteria:** *Know how and when to move people in and out of the team environment.*

**Measurement Criteria:** *Recognize characteristics of effective teams.*

**Measurement Criteria:** *Explain the role of a team on a project.*

**Measurement Criteria:** *Use teamwork skills to achieve goals, solve problems, and manage conflict.*

**Measurement Criteria:** *Be involved in mentor/mentored relationships.*

**Measurement Criteria:** *Give and receive feedback constructively.*

## Cluster Knowledge and Skill Statement

### Ethics and Legal Responsibilities

**Statement:** *Know current ethical and legal standards in the scientific and mathematics as well as the engineering and technology community.*

**Performance Element:** Adhere to ethical and legal standards.

- Measurement Criteria:** *Evaluate the pros and cons of current ethical questions and scenarios, for example, environmental stewardship, genetic research, and living subjects in research.*
- Measurement Criteria:** *Make ethical decisions when presented with ethical choices or moral dilemmas.*
- Measurement Criteria:** *Comply with ethical standards (code of ethics) for your field.*
- Measurement Criteria:** *Follow legal requirements for the treatment of people in the workplace. (ADA, EEO).*
- Measurement Criteria:** *Follow requirements of regulatory agencies in the scientific, and mathematics, engineering, or technology field (e.g., NFPA, OSHA, EPA, ADA, EOE, FCC).*
- Measurement Criteria:** *Develop personal ethics for real-life situations/experiences in science, technology, engineering, and mathematics.*
- Measurement Criteria:** *Evaluate personal, professional, and organizational ethics.*
- Measurement Criteria:** *Explain fundamentals of patents, trademarks, copyrights, and proprietary information.*
- Measurement Criteria:** *Compare and contrast personal ethical values with various professional and organizational codes of ethics.*
- Measurement Criteria:** *Recognize and refute misleading information.*
- Measurement Criteria:** *Evaluate methods for protecting and conserving resources.*

## Cluster Knowledge and Skill Statement

### Employability and Career Development

**Statement:** *Identify patterns, relations, and functions of an organization or a workplace.*

**Performance Element:** Study the essential parts of an organization or a workplace for the purpose of future employment.

**Measurement Criteria:** *Demonstrate ability to gather information about an organization.*

**Measurement Criteria:** *Evaluate and compare employment or advancement opportunities.*

**Statement:** *Exhibit continuous improvement for personal and professional growth.*

**Performance Element:** Develop skills and knowledge for career growth.

**Measurement Criteria:** *Identify and participate in continuous education opportunities.*

**Measurement Criteria:** *Engage in continuous self-assessment and goals modification for personal and professional growth.*

**Measurement Criteria:** *Participate in professional or trade organizations.*

**Performance Element:** Identify performance expectations of a job.

**Measurement Criteria:** *Practice good work habits/time management.*

**Measurement Criteria:** *Be a team player.*

**Measurement Criteria:** *Demonstrate respectful behavior in workplace.*

**Measurement Criteria:** *Maintain knowledge and skills.*

**Measurement Criteria:** *Describe benefits of certifications for various career paths.*

**Statement:** *Research career pathways in science, technology, engineering, and mathematics.*

**Performance Element:** Engage in a large variety of science, technology, engineering, or mathematics experiences to determine personal interest in respective pathways.

**Measurement Criteria:** *List resources for researching funding sources for scientific projects and technology.*

**Measurement Criteria:** *List careers that you have investigated, internships that you could apply for, and job shadowing opportunities that you have identified.*

**Measurement Criteria:** *Construct and maintain a portfolio of experiences and accomplishments.*

## **Section III – Pathway Knowledge and Skills**

## **PATHWAY: Engineering and Technology**

### **Pathway Topic: Academic Foundations**

**Pathway KS Statement:** *Apply concepts and processes as defined by the National Council of Teachers of Mathematics in Principles and Standards for School Mathematics.*

**Performance Element:** Choose and or create models that can be used to solve problems.

**Measurement Criteria:** *Recognize appropriate models, concepts, and processes for the situation, and apply them in solving the problem.*

**Measurement Criteria:** *Explain the impact of assumptions, initial conditions, boundary conditions, and other constraints on problem solutions.*

**Measurement Criteria:** *Use algebraic, geometric and trigonometric relationships, characteristics, and properties to solve problems.*

**Measurement Criteria:** *Evaluate mathematical solutions for reasonableness.*

**Performance Element:** Select and use appropriate statistical methods to analyze data to help make decisions.

**Measurement Criteria:** *Apply appropriate data collection and analysis methods and means of displaying data.*

**Measurement Criteria:** *Apply concepts of probability to help make decisions.*

**Measurement Criteria:** *Apply concepts of data collection and displaying data.*

**Pathway KS Statement:** *Apply concepts and processes as defined by the National Research Council in the National Science Education Standards, and by the American Association for the Advancement of Science in Benchmarks for Science Literacy.*

**Performance Element:** Use systems of measurement.

**Measurement Criteria:** *Convert units of measurement from one system to the other.*

**Measurement Criteria:** *Use measurement systems to solve problems.*

**Performance Element:** Differentiate between scalar and vector quantities.

**Measurement Criteria:** *List quantities that can be represented by scalar and vector.*

**Measurement Criteria:** *Describe the relations between position, velocity, and acceleration in vector terms.*

**Performance Element:** Apply fundamental laws and principles relevant to engineering and technology.

**Measurement Criteria:** *Use Newton's Laws of motion to analyze static and dynamic systems with and without the presence of external forces.*

**Measurement Criteria:** *Use the laws of conservation of energy, charge, and momentum to solve a variety of problems involving mechanical, fluid, chemical (atomic), nuclear, biological, electrical, and thermal systems.*

**Measurement Criteria:** *Use the relationships between energy, work, and power to solve a variety of problems involving mechanical, fluid, electrical, and thermal systems.*

**Measurement Criteria:** *Use the principles of ray optics to describe reflection and refraction of light.*



## Pathway Topic: Academic Foundations

**Measurement Criteria:** *Identify relevant chemical, mechanical, biological, electrical, and physical properties of materials used in engineering projects.*

**Measurement Criteria:** *Describe the relations between amplitude, wavelength, frequency, period, and speed of a wave.*

**Measurement Criteria:** *Explain the relationships between scientific theory, scientific principles and laws, and technology.*

### **Pathway KS Statement: Apply concepts and processes as defined in the Standards for Technological Literacy: Content for the Study of Technology.**

**Performance Element:** Use mathematics, science and technology concepts and processes to solve problems quantitatively in engineering projects involving design, development, or production in various technologies.

**Measurement Criteria:** *Explain and apply concepts in medical technologies.*

**Measurement Criteria:** *Explain and apply concepts in agricultural and related biotechnologies.*

**Measurement Criteria:** *Explain and apply concepts in energy and power technologies.*

**Measurement Criteria:** *Explain and apply concepts in information and communication.*

**Measurement Criteria:** *Explain and apply concepts in transportation technologies.*

**Measurement Criteria:** *Explain and apply concepts in manufacturing technologies.*

**Measurement Criteria:** *Explain and apply concepts in construction technologies.*

**Performance Element:** Apply the core concepts of technology and recognize their relationships with engineering, science and math, and other subjects.

**Measurement Criteria:** *Explain and apply the core concepts of systems in technology and engineering projects.*

**Measurement Criteria:** *Explain and apply the core concepts of resources in technology and engineering projects.*

**Measurement Criteria:** *Explain and apply the core concepts of criteria and constraints in technology and engineering projects.*

**Measurement Criteria:** *Explain and apply the core concepts of optimization and trade-off in technology and engineering projects.*

**Measurement Criteria:** *Explain and apply the core concepts of processes in technology and engineering projects.*

**Measurement Criteria:** *Explain and apply the core concepts of controls in technology and engineering projects.*

## Pathway Topic: Information Technology Applications

### **Pathway KS Statement: Use information technology applications.**

**Performance Element:** Use computer applications to solve problems.

**Measurement Criteria:** *Create and use algorithms.*

**Measurement Criteria:** *Use simulation, modeling, prototype techniques to solve problems.*

**Performance Element:** Select and use different forms of communications technology.

**Measurement Criteria:** *Use word processing, spread sheet, database and presentation software.*

**Measurement Criteria:** *Use the Internet to search for and display information.*

## **Pathway Topic: Information Technology Applications**

**Measurement Criteria:** *Use e-mail to communicate.*

**Performance Element:** **Collect, manage, display data.**

**Measurement Criteria:** *Use probes and sensors to collect data.*

**Measurement Criteria:** *Create engineering drawings.*

**Measurement Criteria:** *Select and use Information Technology tools to analyze and synthesize data.*

## **Pathway KS Statement: Manage, develop, and improve Information Technology (IT) tools.**

**Performance Element:** **Develop and deploy information technology tools.**

**Measurement Criteria:** *Select and use IT tools that are compatible with existing and emerging systems.*

**Measurement Criteria:** *Apply protocols for hardware communication (e.g. networking).*

**Measurement Criteria:** *Adapt/deploy technical support strategies.*

**Measurement Criteria:** *Analyze system feedback and take appropriate action.*

## **Pathway Topic: Technical Skills**

### **Pathway KS Statement: Apply technological content concepts, and principles.**

**Performance Element:** **Discover how things work.**

**Measurement Criteria:** *Demonstrate knowledge of technology and troubleshooting.*

**Measurement Criteria:** *Use problem solving in engineering and technology.*

**Measurement Criteria:** *Be able to distinguish between hardware/software problems.*

**Performance Element:** **Use appropriate “tools of the trade.”**

**Measurement Criteria:** *Apply concepts of planning.*

**Measurement Criteria:** *Apply concepts of designing.*

**Measurement Criteria:** *Apply concepts of building.*

**Measurement Criteria:** *Apply concepts of testing.*

**Measurement Criteria:** *Apply concepts of quality assurance.*

**Measurement Criteria:** *Apply concepts of customer needs.*

**Measurement Criteria:** *Use measuring systems, devices.*

**Measurement Criteria:** *Correlate quality practices with business outcomes.*

**Measurement Criteria:** *Use appropriate modeling tools.*

**Performance Element:** **Differentiate between related elements of engineering and technology.**

**Measurement Criteria:** *Conduct research and development.*

**Measurement Criteria:** *Conduct experimentation and application.*

**Measurement Criteria:** *Practice invention and innovation.*

**Measurement Criteria:** *Apply principles of theory and fact.*

### **Pathway KS Statement: Model technical competence.**

**Performance Element:** **Use effective project and system management.**

**Measurement Criteria:** *Apply the processes needed to complete a project.*

**Measurement Criteria:** *Develop and implement a plan for a project.*

**Measurement Criteria:** *Contribute as a team member in completing a project.*

## Pathway Topic: Technical Skills

**Measurement Criteria:** *Predict end results.*

**Measurement Criteria:** *Determine changes needed in a process or product to meet a change in design, constraints, or requirements.*

**Measurement Criteria:** *Use appropriate time management practices.*

**Measurement Criteria:** *Apply effective organizational skills.*

**Performance Element:** **Use precision measuring methods and instruments.**

**Measurement Criteria:** *Record data with the correct number of significant figures.*

**Measurement Criteria:** *Explain the impact of error and uncertainty in measurement.*

**Measurement Criteria:** *Predict the effect of error propagation in calculations.*

**Performance Element:** **Safely operate and use a variety of tools, machines, equipment and materials.**

**Measurement Criteria:** *Handle and store tools and materials correctly.*

**Measurement Criteria:** *Perform basic maintenance.*

**Measurement Criteria:** *Describe the results of negligent or improper maintenance, or of improper calibration.*

**Performance Element:** **Apply elements of engineering and technology.**

**Measurement Criteria:** *Conduct analysis of costs, resources, production capacity, customer satisfaction, quality.*

**Measurement Criteria:** *Use appropriate problem-solving techniques.*

**Measurement Criteria:** *Use optimization.*

## Pathway Topic: Design

**Pathway KS Statement:** **Examine elements of the design process.**

**Performance Element:** **Examine the history of innovation and invention.**

**Measurement Criteria:** *Define innovation and invention.*

**Measurement Criteria:** *Research the history of inventors and innovators.*

**Measurement Criteria:** *Research the interrelationship between society and innovation.*

**Performance Element:** **Apply concepts of design.**

**Measurement Criteria:** *Examine attributes of design in systems.*

**Measurement Criteria:** *Examine attributes of design in products.*

**Measurement Criteria:** *Examine attributes of design in services.*

**Measurement Criteria:** *Examine design constraints in regard to manufacturability.*

**Measurement Criteria:** *Examine design constraints in regard to testability.*

**Measurement Criteria:** *Examine design constraints in regard to maintainability.*

**Measurement Criteria:** *Examine design constraints in regard to cost.*

**Measurement Criteria:** *Examine design constraints in regard to human resources.*

**Measurement Criteria:** *Examine design constraints in regard to environmental factors.*

**Measurement Criteria:** *Examine design constraints in regard to technology.*

**Measurement Criteria:** *Identify design trends.*

**Measurement Criteria:** *Examine trade-offs.*

**Pathway KS Statement:** **Demonstrate and apply the design process.**

**Performance Element:** **Design a system, product or service.**

**Measurement Criteria:** *Interpret and produce design criteria.*

## Pathway Topic: Design

**Measurement Criteria:** *Solve a problem to achieve given specifications with considerations to constraints.*

**Measurement Criteria:** *Incorporate human, environmental and technological factors in the design process.*

**Measurement Criteria:** *Apply risk analysis in the design process.*

**Measurement Criteria:** *Employ reverse engineering principles.*

**Performance Element:** **Access, test, record, organize and evaluate information needed to alter the design of a product, system or service.**

**Measurement Criteria:** *Interpret and evaluate accuracy of information.*

**Measurement Criteria:** *Improve a product, service or system to meet requirements based on feedback and analysis.*

## **PATHWAY: Science and Mathematics**

### **Pathway Topic: Academic Foundations**

**Pathway KS Statement: Understand how science and mathematics function as an active component of the real world.**

**Performance Element: Apply science and mathematics concepts and principles of inquiry.**

**Measurement Criteria:** *Describe the inquiry process and apply the skills necessary to engage in inquiry.*

**Measurement Criteria:** *Apply the methods and tools for research and investigation.*

**Measurement Criteria:** *Conduct experiments in a laboratory.*

**Performance Element: Use a broad knowledge of science and mathematics to communicate with the global community.**

**Measurement Criteria:** *Acquire competency in foundation science and mathematics subjects such as physical science, biological science, chemical science, mathematical science, and social science.*

**Measurement Criteria:** *Write and or graphically describe the interrelationship of an individual to his/her organization and overall environment.*

**Measurement Criteria:** *Broaden knowledge and skills in science and mathematics through co-op/internship experiences, science fairs, reading publications, job shadowing, and continuing education.*

**Measurement Criteria:** *Interact and communicate with the scientific community.*

**Measurement Criteria:** *Communicate and contribute to broader community and society in a meaningful way.*

**Performance Element: Access, share and use data.**

**Measurement Criteria:** *Apply techniques for observation and gathering data.*

**Measurement Criteria:** *Apply techniques for creating data.*

**Measurement Criteria:** *Apply techniques for processing and interpreting data.*

**Measurement Criteria:** *Apply techniques for sharing data.*

**Measurement Criteria:** *Explain the advantages and disadvantages of using various technological tools in data management.*

**Performance Element: Integrate science, mathematics, technology, and engineering concepts and content.**

**Measurement Criteria:** *Write or describe graphically the interdependency of science, mathematics, technology, and engineering concepts and content.*

**Pathway KS Statement: Apply essential concepts and skills for proficiency in science and mathematics in real-world situations.**

**Performance Element: Apply the scientific method.**

**Measurement Criteria:** *Apply data analysis methods.*

**Measurement Criteria:** *Apply basic scientific research.*

**Measurement Criteria:** *Construct a testing model.*

**Measurement Criteria:** *Organize records and files to maintain data.*

**Measurement Criteria:** *Define hypothesis.*

**Measurement Criteria:** *Graph a dependent versus independent variable.*

## Pathway Topic: Academic Foundations

**Performance Element: Recognize cause and effect.**

**Measurement Criteria:** *Write a report illustrating cause and effect phenomena in the physical environment.*

**Performance Element: Differentiate between science and pseudoscience.**

**Measurement Criteria:** *Define science and pseudoscience.*

**Measurement Criteria:** *Compare and contrast science and pseudoscience.*

**Performance Element: Draw a conclusion from a series of observations.**

**Measurement Criteria:** *Write a report that details how your conclusion is supported by a series of observations.*

**Performance Element: Recognize measurable attributes of objects, units, systems and processes.**

**Measurement Criteria:** *List examples each of measurable attributes for objects, units, systems, and processes.*

**Measurement Criteria:** *Solve a linear set of equations for unknowns.*

**Performance Element: Analyze change in various contexts.**

**Measurement Criteria:** *List examples of change and its context, in science, and in mathematics.*

**Performance Element: Research a topic.**

**Measurement Criteria:** *Compile research about the topic.*

**Measurement Criteria:** *Develop research report.*

**Measurement Criteria:** *Present research report.*

**Performance Element: Organize problems into manageable parts.**

**Measurement Criteria:** *Write an outline of an approach to researching a problem, illustrating how to organize the problem into manageable parts.*

**Performance Element: Use qualitative and quantitative skills to conduct a simple scientific survey.**

**Measurement Criteria:** *Present a summary of the results of a simple scientific survey.*

**Performance Element: Predict outcomes of an experiment.**

**Measurement Criteria:** *Write a statement describing a null hypothesis.*

**Performance Element: Defend opinions using fact.**

**Measurement Criteria:** *Write a paragraph in which the topic sentence states an opinion that is supported by three statements of fact.*

**Pathway KS Statement: Assess the impact that science and mathematics has on society.**

**Performance Element: Evaluate the impact of science on society.**

**Measurement Criteria:** *Write an essay describing the impact of science on society.*

**Performance Element: Evaluate the impact of mathematics on society.**

**Measurement Criteria:** *Write an essay describing the impact of mathematics on society.*

**Performance Element: Investigate how science and mathematics influence professions and occupations within the cluster.**

## Pathway Topic: Academic Foundations

**Measurement Criteria:** *Select a profession or an occupation and describe its relationship to science or mathematics.*

## Pathway Topic: Problem Solving and Critical Thinking

**Pathway KS Statement:** *Use scientific and mathematical problem-solving skills to produce viable solutions to problems.*

**Performance Element:** Demonstrate effective problem solving techniques.

**Measurement Criteria:** *Identify the solution to a specific problem.*

**Measurement Criteria:** *Develop a project plan and timeline.*

**Measurement Criteria:** *Make efficient use of time and resources to complete work.*

**Performance Element:** Apply appropriate scientific methodology.

**Measurement Criteria:** *Use scientific method to research/investigate a specific scientific or mathematical problem.*

**Measurement Criteria:** *Form a problem statement.*

**Measurement Criteria:** *Construct a solution to a problem.*

**Performance Element:** Use analytical tools and techniques to solve problems, construct tests, and evaluate data.

**Measurement Criteria:** *Evaluate data.*

**Measurement Criteria:** *Construct an appropriate statistical test.*

**Measurement Criteria:** *Apply scientific and mathematical principles to a qualitative problem.*

**Measurement Criteria:** *Analyze a problem.*

**Pathway KS Statement:** *Use critical thinking skills to translate, interpret, and summarize research and statistical data.*

**Performance Element:** Use effective critical thinking skills.

**Measurement Criteria:** *Translate, interpret, and summarize research and statistical data.*

**Measurement Criteria:** *Draw a conclusion based on observations and experimental results.*

**Measurement Criteria:** *Recognize, verify, and implement an appropriate solution to a problem.*

**Measurement Criteria:** *Break down a complex scientific system into basic components.*

**Measurement Criteria:** *Identify weaknesses/defects within a system and propose solutions.*

## Pathway Topic: Technical Skills

**Pathway KS Statement:** *Demonstrate knowledge and application of technical skills needed in a chosen scientific and mathematical field.*

**Performance Element:** Design, operate, and maintain technological systems and equipment.

**Measurement Criteria:** *Engage in technical certification and continuous education opportunities in design, operation, and maintenance.*

**Performance Element:** Collect information, change/modify materials, and conduct experiments, using appropriate tools.

**Measurement Criteria:** *Write a report describing how to collect information,*

## Pathway Topic: Technical Skills

*change/modify materials, conduct experiments, using appropriate tools.*

**Measurement Criteria:** *Use appropriate tools for a given application.*

**Measurement Criteria:** *Calibrate equipment.*

**Measurement Criteria:** *Measure the results of an experiment/test.*

**Performance Element:** **Determine appropriate uses of technology.**

**Measurement Criteria:** *Provide examples of scientific or mathematical technology and their uses.*

**Performance Element:** **Critically evaluate data.**

**Measurement Criteria:** *Summarize data evaluations.*



## **Section IV – O\*NET Crosswalk Report**

# Career Specialty/ Occupational Coding and Crosswalk

## Summary

The objective of the Career Specialty/ Occupational Coding and Crosswalk project is to accomplish two basic tasks. The first is to design and establish a classification and coding structure for the States' Career Clusters Initiative. When completed, the classification and coding structure will be compatible with existing occupational classification systems and designed in a manner that allows for easy updating and the flexibility to add additional career pathways and occupational specialties.

Once the first step is completed for each cluster, the second step is to build a linkage system or crosswalk between the new career cluster classification system and the O\*NET occupational classification system developed and operated by the U S Department of Labor. O\*NET is a nationally recognized taxonomy with detailed descriptions and a rich database of information for each occupation.

## Explanation of Crosswalk Table

The attached table lists each occupational specialty and its related O\*NET occupation. It is sequenced by career pathway and occupational specialty code. It should be noted that the relationship between an occupational specialty and its related O\*NET occupation is often not one-to-one. The O\*NET occupation is often much broader covering two or more occupational specialties. In fact, even when multiple occupational specialties are assigned, they may only represent a part of a broader O\*NET occupation.

Column 1: Lists occupational specialties that were identified by the Career Clusters Initiative. The occupational specialties are organized by cluster pathways and represent occupational titles with no definitions. They are intended to be a sample of occupations that help define the cluster and pathway.

Column 2: Represents related occupations from the O\*NET occupational coding system.

**Note: A crosswalk from the occupational specialties to the Classification of Instructional Programs (CIP) codes is forthcoming. The National Crosswalk Service Center is currently developing the CIP to O\*NET crosswalk which will be the bridge to the career cluster occupational specialties. You may access this crosswalk in the near future at: <http://www.xwalkcenter.org/>**

**Science, Technology, Engineering and Mathematics Career Cluster: Occupational Specialties and Related O\*NET Occupations,  
Sequenced by Career Pathway and Occupational Specialty Code**

Occupational Specialties		Related SOC/O*NET Occupation	
Code	Title	Code	Title
<b>15.10000</b>	<b>Engineering and Technology Pathway</b>		
15.10010	Safety Engineering	17-2111.00	Health and Safety Engineers, Except Mining Safety Engineers and Inspectors
15.10010	Safety Engineering	17-2111.01	Industrial Safety and Health Engineers
15.10020	Fire Protection Engineering	17-2111.02	Fire-Prevention and Protection Engineers
15.10030	Electrical Safety	17-2111.01	Industrial Safety and Health Engineers
15.10040	Failure Analysis	17-2111.01	Industrial Safety and Health Engineers
15.10040	Failure Analysis	17-2111.03	Product Safety Engineers
15.10050	Hazardous Waste Engineering	17-2081.00	Environmental Engineers
15.10060	Industrial Engineering	17-2112.00	Industrial Engineers
15.10070	Quality Engineer	17-2112.00	Industrial Engineers
15.10080	Facilities Engineer	17-2141.00	Mechanical Engineers
15.10090	Cost Engineer	17-2112.00	Industrial Engineers
15.10100	Operations Research Engineer	17-2112.00	Industrial Engineers
15.10110	Manufacturing Engineer	17-2112.00	Industrial Engineers
15.10120	Manufacturing Processes Engineer	17-2112.00	Industrial Engineers
15.10130	Welding	17-2131.00	Materials Engineers
15.10140	Packaging Engineer	17-2112.00	Industrial Engineers
15.10150	Mechanical Engineering-HVAC	17-2141.00	Mechanical Engineers
15.10160	Propulsion	17-2141.00	Mechanical Engineers
15.10160	Propulsion	17-2011.00	Aerospace Engineers
15.10170	Mechanical Drafters	17-3013.00	Mechanical Drafters
15.10180	Electrical Engineering	17-2071.00	Electrical Engineers
15.10190	Energy Transmission Engineer	17-2071.00	Electrical Engineers
15.10200	Power Systems Engineer	17-2071.00	Electrical Engineers
15.10210	Acoustic Engineer	17-2199.00	Engineers, All Other
15.10220	EMC/EMI Engineer	17-2071.00	Electrical Engineers
15.10230	Sound Engineer	27-4014.00	Sound Engineering Technicians
15.10240	Radio/TV Broadcast Engineer	27-4012.00	Broadcast Technicians
15.10250	Communications Engineer	17-2072.00	Electronics Engineers, Except Computer
15.10260	Electrical Technician	17-3023.00	Electrical and Electronic Engineering Technicians
15.10270	Emerging Engineers	99-9999.00	No comparable O*NET Occupation
15.10280	Photonics	17-2199.00	Engineers, All Other

**Science, Technology, Engineering and Mathematics Career Cluster: Occupational Specialties and Related O\*NET Occupations,  
Sequenced by Career Pathway and Occupational Specialty Code**

Occupational Specialties		Related SOC/O*NET Occupation	
Code	Title	Code	Title
15.10290	Nanotechnology	17-2199.00	Engineers, All Other
15.10300	Optical Engineering	17-2199.00	Engineers, All Other
15.10310	Materials Engineering	17-2131.00	Materials Engineers
15.10320	Ceramics	17-2131.00	Materials Engineers
15.10330	Metallurgic Engineer	17-2131.00	Materials Engineers
15.10340	Plastics Engineer	17-2131.00	Materials Engineers
15.10350	Polymer Engineer	17-2131.00	Materials Engineers
15.10360	Textile Engineer	17-2131.00	Materials Engineers
15.20000	<b>Professional Engineering Pathway</b>		
15.20010	Statistician	15-2041.00	Statisticians
15.20020	Standards Writing	27-3042.00	Technical Writers
15.20030	Human Factors	99-9999.00	Insufficient information to classify
15.20040	Application Engineer	17-2199.00	Engineers, All Other
15.20050	Instrumentation	17-2141.00	Mechanical Engineers
15.20060	Project Manager	11-1021.00	General and Operations Managers
15.20060	Project Manager	11-3021.00	Computer and Information Systems Managers
15.20070	Licensing Engineer	99-9999.00	Insufficient information
15.20080	Research and Design Engineer	99-9999.00	To broad to classify to a specific O*NET occupation
15.20090	Systems Design Engineer	15-1031.00	Computer Software Engineers, Applications
15.20090	Systems Design Engineer	15-1032.00	Computer Software Engineers, Systems Software
15.20100	Product Design Engineer	99-9999.00	To broad to classify to a specific O*NET occupation
15.20110	Prototype Engineer	99-9999.00	To broad to classify to a specific O*NET occupation
15.20120	Materials Lab and Supply Engineer	99-9999.00	To broad to classify to a specific O*NET occupation
15.20130	Engineering Research	99-9999.00	To broad to classify to a specific O*NET occupation
15.20140	Civil Engineering	17-2051.00	Civil Engineers
15.20150	Construction Engineer	17-2051.00	Civil Engineers
15.20160	Structural Engineer	17-2051.00	Civil Engineers
15.20170	Environmental Engineer	17-2081.00	Environmental Engineers
15.20180	Mining Engineer	17-2151.00	Mining and Geological Engineers, Including Mining Safety Engineers
15.20190	Surveying	17-3031.01	Surveying Technicians
15.20200	Geothermal Engineer	17-2051.00	Civil Engineers
15.20210	Civil Drafters	17-3011.02	Civil Drafters

**Science, Technology, Engineering and Mathematics Career Cluster: Occupational Specialties and Related O\*NET Occupations,  
Sequenced by Career Pathway and Occupational Specialty Code**

Occupational Specialties		Related SOC/O*NET Occupation	
Code	Title	Code	Title
15.20220	Architectural Drafters	17-3011.01	Architectural Drafters
15.20230	Architectural Engineer	17-2051.00	Civil Engineers
15.20240	Chemical Engineering	17-2041.00	Chemical Engineers
15.20250	Petroleum Engineer	17-2171.00	Petroleum Engineers
15.20260	Medical Engineer	17-2031.00	Biomedical Engineers
15.20270	Pharmaceutical Engineer	17-2199.00	Engineers, All Other
15.20280	Biological Engineering	17-2031.00	Biomedical Engineers
15.20290	Biotechnology Engineer	17-2031.00	Biomedical Engineers
15.20300	Biomedical Engineer	17-2031.00	Biomedical Engineers
15.20310	Agricultural Engineering	17-2021.00	Agricultural Engineers
15.20320	Marine Engineering	17-2121.01	Marine Engineers
15.20330	Ocean Engineer	17-2121.01	Marine Engineers
15.20340	Naval Engineer	17-2121.01	Marine Engineers
15.20350	Information Technologies	15-1031.00	Computer Software Engineers, Applications
15.20350	Information Technologies	15-1032.00	Computer Software Engineers, Systems Software
15.20350	Information Technologies	15-1041.00	Computer Support Specialists
15.20350	Information Technologies	15-1051.00	Computer Systems Analysts
15.20350	Information Technologies	15-1061.00	Database Administrators
15.20350	Information Technologies	15-1071.00	Network and Computer Systems Administrators
15.20350	Information Technologies	15-1071.01	Computer Security Specialists
15.20350	Information Technologies	15-1081.00	Network Systems and Data Communications Analysts
15.20360	Computer Engineer	17-2061.00	Computer Hardware Engineers
15.20360	Computer Engineer	15-1031.00	Computer Software Engineers, Applications
15.20360	Computer Engineer	15-1032.00	Computer Software Engineers, Systems Software
15.20370	Networking Engineer	15-1081.00	Network Systems and Data Communications Analysts
15.20380	Computer Scientist	15-1011.00	Computer and Information Scientists, Research
15.20390	Telecommunications	17-2071.00	Electrical Engineers
15.20400	Data Engineer	15-1061.00	Database Administrators
15.20410	Software Engineer	15-1031.00	Computer Software Engineers, Applications
15.20410	Software Engineer	15-1032.00	Computer Software Engineers, Systems Software
15.20420	Aerospace Engineering	17-2011.00	Aerospace Engineers
15.20430	Thermal Engineer	17-2011.00	Aerospace Engineers
15.20440	Rocket Scientist	17-2011.00	Aerospace Engineers

**Science, Technology, Engineering and Mathematics Career Cluster: Occupational Specialties and Related O\*NET Occupations,  
Sequenced by Career Pathway and Occupational Specialty Code**

Occupational Specialties		Related SOC/O*NET Occupation	
Code	Title	Code	Title
15.20450	Transportation Engineering	99-9999.00	To broad to classify to a specific O*NET occupation
15.20460	Automotive Engineer	17-2141.00	Mechanical Engineers
15.20470	Traffic Engineer	17-2071.00	Electrical Engineers
15.20480	Nuclear Engineering	17-2161.00	Nuclear Engineers
15.20490	Nuclear Energy Generation	17-2161.00	Nuclear Engineers
<b>15.30000</b>	<b>Science and Mathematics Pathway</b>		
15.30010	Geoscientist	19-2042.00	Geoscientists, Except Hydrologists and Geographers
15.30010	Geoscientist	19-2043.00	Hydrologists
15.30020	Marine scientist	19-2043.00	Hydrologists
15.30030	Environmental scientist	19-2041.00	Environmental Scientists and Specialists, Including Health
15.30040	Expert systems scientist	99-9999.00	Insufficient information to classify
15.30050	Atmospheric scientist	19-2021.00	Atmospheric and Space Scientists
15.30060	Conservation scientist	19-1031.00	Conservation Scientists
15.30070	Quality control scientist	99-9999.00	No comparable O*NET occupation
15.30080	Space scientist	19-2021.00	Atmospheric and Space Scientists
15.30090	Polymer scientist	19-2032.00	Materials Scientists
15.30100	Protein scientist	19-2031.00	Chemists
15.30110	Materials scientist	19-2032.00	Materials Scientists
15.30120	Optical scientist	19-2012.00	Physicists
15.30130	Chemist	19-2031.00	Chemists
15.30140	Dye chemist	19-2031.00	Chemists
15.30150	Biochemist	19-1021.01	Biochemists
15.30160	Inorganic chemist	19-2031.00	Chemists
15.30170	Research chemist	19-2031.00	Chemists
15.30180	Analytical Chemist	19-2031.00	Chemists
15.30190	Organic chemist	19-2031.00	Chemists
15.30200	Radio chemist	19-2031.00	Chemists
15.30210	Nuclear chemists	19-2031.00	Chemists
15.30220	Statistician	15-2041.00	Statisticians
15.30230	Applied mathematician	15-2021.00	Mathematicians
15.30240	Mathematics	15-2021.00	Mathematicians
15.30250	Numerical analyst	15-2021.00	Mathematicians

**Science, Technology, Engineering and Mathematics Career Cluster: Occupational Specialties and Related O\*NET Occupations,  
Sequenced by Career Pathway and Occupational Specialty Code**

Occupational Specialties		Related SOC/O*NET Occupation	
Code	Title	Code	Title
15.30260	Economist	19-3011.00	Economists
15.30270	Ecologist	19-1023.00	Zoologists and Wildlife Biologists
15.30280	Cosmologist	19-2021.00	Atmospheric and Space Scientists
15.30290	Endocrinologist	19-1042.00	Medical Scientists, Except Epidemiologists
15.30300	Photonist	19-2012.00	Physicists
15.30310	Zoologist	19-1023.00	Zoologists and Wildlife Biologists
15.30320	Genetisist	19-1029.00	Biological scientist,All Other
15.30330	Spectroscopist	19-4031.00	Chemical Technicians
15.30340	Toxicologist	19-1042.00	Medical Scientists, Except Epidemiologists
15.30350	Mycologist	19-1029.00	Biological scientist,All Other
15.30360	Xenobiologist	19-1029.00	Biological scientist,All Other
15.30370	Herpetologist	19-1023.00	Zoologists and Wildlife Biologists
15.30380	Ichthyologist	19-1023.00	Zoologists and Wildlife Biologists
15.30390	Metallurgist	17-2131.00	Materials Engineers
15.30400	Ornithologist	19-1023.00	Zoologists and Wildlife Biologists
15.30410	Protozoologist	19-1023.00	Zoologists and Wildlife Biologists
15.30420	Mammologist	19-1023.00	Zoologists and Wildlife Biologists
15.30430	Nanobiologist	19-1029.00	Biological scientist,All Other
15.30440	Paleontologist	19-2042.00	Geoscientists, Except Hydrologists and Geographers
15.30450	Botanist	19-1099.00	Life Scientist, All Other
15.30460	Nutritionist	29-1031.00	Dietitians and Nutritionists
15.30470	Meteorologist	19-2021.00	Atmospheric and Space Scientists
15.30480	Hydrologist	19-2043.00	Hydrologists
15.30490	Electronmicroscopist	19-1022.00	Microbiologists
15.30500	Microbial Physiologist	19-1022.00	Microbiologists
15.30510	Physicist	19-2012.00	Physicists
15.30520	Geologist	19-2042.01	Geologists
15.30530	Archeologist	19-3091.02	Archeologists
15.30540	Anthropologist	19-3091.01	Anthropologists
15.30550	Geophysicist	19-2042.01	Geologists
15.30560	Astrologist	27-2099.00	Entertainers and Performers, Sports and Related Workers, All Other
15.30570	Astrophysicist	19-2012.00	Physicists
15.30580	Astronomer	19-2011.00	Astronomers

**Science, Technology, Engineering and Mathematics Career Cluster: Occupational Specialties and Related O\*NET Occupations,  
Sequenced by Career Pathway and Occupational Specialty Code**

Occupational Specialties		Related SOC/O*NET Occupation	
Code	Title	Code	Title
15.30590	Crystallographer	19-2042.01	Geologists
15.30600	Demographer	19-3099.00	Social Scientist and Related Workers, All Other
15.30610	Cryptographer	15-2021.00	Mathematicians
15.30620	Oceanographer	19-2042.00	Geoscientists, Except Hydrologists and Geographers
15.30630	Science teacher Lab Technician	25-1194.00	Vocational Education Teachers Postsecondary
15.30640	Nuclear technician	19-4051.00	Nuclear Technicians
15.30650	Technologist	99-9999.00	To broad to classify to a specific O*NET occupation
15.30660	CAD support	17-3013.00	Mechanical Drafters
15.30670	Scientific visualization / graphics expert	27-1024.00	Graphic Designers
15.30680	Communications technologist	27-4011.00	Audio and Video Equipment Technicians
15.30680	Communications technologist	27-4012.00	Broadcast Technicians
15.30680	Communications technologist	27-4013.00	Radio Operators
15.30680	Communications technologist	27-4014.00	Sound Engineering Technicians
15.30690	Cartographer	17-3031.00	Surveying and Mapping Technicians
15.30700	Vacuum technologist	19-4099.00	Life, Physical, and Social Science Technicians, All Other
15.30710	Technical writer	27-3042.00	Technical Writers
15.30720	Programmer	15-1021.00	Computer Programmers
15.30730	Materials analyst	19-2032.00	Materials Scientists



## **Section V – Cluster Profile Advisory Committee List**

# Career Cluster Profile

**Cluster Name:** Science, Technology, Engineering and Mathematics

**Project Lead States:** North Carolina

**Project Lead State Contact Information:**

Tom Shown, Project Director  
Public Schools of North Carolina  
301 North Wilmington St  
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**Cluster Coordinators:** Greg Dewald

**Cluster Definition:** Planning, managing, and providing scientific research and professional and technical services (e.g., physical science, social science, engineering) including laboratory and testing services, and research and development services.

**Cluster Pathways:** Engineering, Science

**Cluster Partners:** List attached.

**Number of cluster partners in each of the following categories:**

<b>Postsecondary Education:</b>	<u>11</u>
<b>Secondary Education:</b>	<u>7</u>
<b>Business &amp; Industry</b>	<u>14</u>
<b>Labor</b>	<u>1</u>
<b>Associations</b>	<u>3</u>
<b>Government Agencies</b>	<u>4</u>

## Deliverable #1: Science, Technology, Engineering and Mathematics Cluster Advisory Committee Members

Name	Title	Organization/ Company/School	Address	City	State, ZIP	Phone	E-mail	**Pathway
Nancy Anselmini	SciVis Teacher	Lucy Ragsdale High School	602 High Point Road	Jamestown	NC27282	(336) 819-2960	anselmini@hotmail.com	Science
June Atkinson	Director	NCDPI	301 N. Wilmington Street	Raleigh	NC27601	(919) 807-3815	jatkinso@dpi.state.nc.us	Lead State Dir.
Rick Barton		Bayer				(919) 553-5011		Science
Leonard Behr	Administrator Authentic Sci Research Program	SUNY Research Foundation	36 Swiss Farms	Hudson	NY12534-3701	(518) 672-7349	lenbehr@mhonline.net	Science
Ray Blaner	Senior Engineering Dept. Manager	Bayer	5509 Lake Edge Drive	Holly Springs	NC27540	(919) 359-4411	ray.blaner.b@bayer.com	Science
Laura Bottomley	Director of Women in Engineering Program	NCSU	118 Page Hall Box 7904	Raleigh	NC27695-7904	(919) 515-2315	laurab@eos.ncsu.edu	Engineering Vise Chair
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Aaron Clark	Professor	NCSU	P.O. Box 2801 Poe Hall	Raleigh	NC27695	(919) 515-1771	aaron_clark@NCSU.EDU	Engineering
Mike Crawford	VP, Curriculum and Materials Development	CORD	601 Lake Air Drive	Waco	TX76710-5841	(254) 772-8756	crawford@cord.org	Engineering
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Greg Dewald	Coordinator	States' Career Clusters	1500 West Seventh Avenue	Stillwater	OK74074	(405) 743-5446	gdewa@careerclusters.org	
William Dugger, Jr.	Director TFAA	Technology For All Americans	1997 S. Main Street Suite 701	Blacksburg	VA24060	(540) 953-0203	duggerw@itea-tfaap.org	Engineering
George Ehrhardt							gre120@aol.com	
John R. Ford	Manager - Technological Vitality	Celestica Inc.	209 Laurelwood Drive	Hopedale	MA01747	(508) 634-6976	jford@celestica.com	Engineering
Chris Griggs	Sci-Vis Teacher	Northwest Guilford High School	5240 NW School Road	Greensboro	NC27409	(336) 605-3300	clg8145@cs.com	
Richard Grimsley	Director of PLTW for the SW & Far West	Project Lead the Way	7806 Epping Lane	Austin	TX78745	(512) 442-5450	richard.grimsley@att.net	Engineering
Robert "Butch"	Dept Head:	Wake Technical	9101 Fayetteville	Raleigh	NC2760	(919) 662-	rhgrove@gwmail.wak	Engineering

February 26, 2002

Name	Title	Organization/ Company/School	Address	City	State, ZIP	Phone	E-mail	**Pathway
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Cici Havens		NCSU		Raleigh	NC	(919) 623-7529		
Carolyn Helm	Director - PLTW	SREB (southern regional edu board)	592 10th Street, NW	Atlanta	GA30318-5790	(404) 879-5598	carolyn.helm@sreb.org	Science
Karen Hollweg	Director	National Science Education Standards				(202) 334-3055		Science
Tammy Jackson	Applications Developer	SAS Institute Inc.	SAS Campus Dr	Cary	NC27513	(919) 677-8000	Tammy.Jackson@sas.com	Math
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Gail Long		Duke Power		Charlotte	NC	(704) 382-1519		Engineering
Tom Lucier	Department Chair	Alamance Community College	200 Westminster #8	Chapel Hill	NC27514	(336) 506-4225	luciert@alamance.cc.nc.us	Science
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Nancy Mills	Dir - Working for America	AFLCIO		Washington	DC	(202) 466-8010		Both
John Morrison	Professor of Physical Oceanography	NCSU	Dept of Marine, Earth Sciences 1125 Jordan Hall, Box 8208	Raleigh	NC27695-8208	(919) 515-7449	John_Morrison@NCSU.EDU	Science
Richard Mowat	Professor of Physics	NCSU	518E Cox Hall, Box 8202 Box 8202	Raleigh	NC27695-8202	(919) 515-7914	Richard_Mowat@ncsu.edu	Science
George Nelson	Director	Science for All Americans				(202) 326-7047		
Stuart Nisbet	Senior R&D Director	SAS Institute	SAS Campus Drive Mailstop R5450	Cary	NC27513	(919) 531-6983	stuart.nisbet@sas.com	science
Joe Peminachia		IBM				(919) 543-9276		
Harold Pratt						(303) 973-4170		
Bill Raiford	Research Manager	Dupont Fluoroproducts	22828 NC Hwy 87W	Fayetteville	NC28306-7332	(910) 678-1172	William.P.Raiford@usa.dupont.com	Science
Cindy Ray		Ericson				(919) 472-		

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Name	Title	Organization/ Company/School	Address	City	State, ZIP	Phone	E-mail	**Pathway
						7011		
Sandra Sherrill	Technical Writer		4909 Richland Drive	Raleigh	NC27612	(919) 828-1666	sandrajsherrill@nc.rr.com	
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Susan Trukawinski		Bayer Corporation	8368 Hwy US-70 West	Clayton	NC27520	(919) 359-4437	Susan.Trukawinski.B@Bayer.com	Science
Bill Tucci	Consultant	NCDPI	301 N. Wilmington Street	Raleigh	NC27601	(919) 807-3845	wtucci@dpi.state.nc.us	Engineering
Joe Waters	Engineering Group Leader	Underwriters Laboratories, Inc.	12 Laboratory Dr. P.O. Box 13995	RTP	NC27709-3995	(919) 549-1727	joseph.m.waters@us.ul.com	Engineering
Ben White	Dean	Wake Technical Community College	9101 Fayetteville Road	Raleigh	NC27603	(919) 662-3375	brwhite@gwmail.wake.tec.nc.us	Engineering
Robin Whitfield	Teachers	New Bern High School	4200 Academic Drive	New Bern	NC28562	(252) 514-6050	mswhitnb@earthlink.net	Science
Bill Woodruff	Department Head	Alamance Community College	1247 Jimmie Kerr Road	Graham	NC27253	(336) 506-4224	Woodruff@alamance.cc.nc.us	

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## **Section VI – Credentials**

## Deliverable #2: Science, Technology, Engineering & Mathematics Sample List of Existing Credentials

(includes licenses, education and industry certificates, as well as postsecondary degree options)

Updated 08/20/02

Education and Industry <i>Licenses</i>		
Title/Type/Descriptor of Licensing Program	Licensing Organization	Source for Contact Information
Aeronautical/Aerospace Engineer	(Varies from State to State)	<a href="http://www.careertools.org">www.careertools.org</a> Search under <i>Licensed Occupations</i> by specific Law, Public Safety and Security occupations, by state, or by agency
Agricultural Engineer	(Varies from State to State)	
Civil and Structural Engineer	(Varies from State to State)	
Control Systems Engineer	(Varies from State to State)	
Electrical and control systems Engineer	(Varies from State to State)	
Environmental Engineer	(Varies from State to State)	
Fire Protection Engineer	(Varies from State to State)	
Industrial Engineer	(Varies from State to State)	
Metallurgical Engineer	(Varies from State to State)	
Mining and Mineral Engineer	(Varies from State to State)	
Nuclear Engineer	(Varies from State to State)	
Petroleum Engineer	(Varies from State to State)	
Intern Engineer	(Varies from State to State)	
Professional Engineer	(Varies from State to State)	
Engineer In-Training	(Varies from State to State)	
Stationary Engineer	(Varies from State to State)	
Environmental Professional	(Varies from State to State)	
Asbestos Consultant	(Varies from State to State)	
Designer of Engineering Systems	(Varies from State to State)	
Physical Science Teachers	(Varies from State to State)	
Animal Scientist	(Varies from State to State)	
Environmental Laboratory Director	(Varies from State to State)	
Soil Scientist	(Varies from State to State)	
Specialist in Chemistry	(Varies from State to State)	
Specialist in Microbiology	(Varies from State to State)	
General Engineering Contractor	(Varies from State to State)	
Certified Scientist	(Varies from State to State)	
Radiographer	(Varies from State to State)	
Geologist	(Varies from State to State)	
Bio-analytical Laboratory Director	(Varies from State to State)	
Nuclear Medicine Technologist	(Varies from State to State)	
Professional Geologist	(Varies from State to State)	
Mathematical	(Varies from State to State)	
Hydrologist	(Varies from State to State)	

## Education and Industry *Certificates*

<b>Title/Type/Descriptor of Certification Program</b>	<b>Issuing Organization</b>	<b>Source for Contact Information</b>
Diplomate, American Board of Medical Microbiology	American Board of Medical Microbiology (ASM)	<a href="http://www.asmta.org/acasrc/aca24.htm">http://www.asmta.org/acasrc/aca24.htm</a>
Diplomate of the American Board of Pathology with Added Qualification in Cytopathology Diplomate of the American Board of Pathology with Special Qualifications in Diplomate of the American Board of Pathology with Special Qualification in Chemical Pathology Diplomate of the American Board of Pathology with Special Qualification in Dermatopathology etc. Blood Banking/Transfusion Medicine	American Board of Pathology (ABP)	<a href="http://www.abpath.org/">http://www.abpath.org/</a>
Added Qualifications in Neuroradiology of the American Board of Radiology Added Qualifications in Pediatric Radiology of the American Board of Radiology Certificate of Added Qualifications in Vascular and Interventional Radiology Diplomate in Diagnostic Radiology of the American Board of Radiology Diplomate in Diagnostic Radiology with Special Competence in Nuclear Radiology of the American Board of Radiology; etc	American Board of Radiology (ABR)	<a href="http://www.theabr.org/">http://www.theabr.org/</a>
Diplomate of the American Board of Toxicology	American Board of Toxicology (ABT)	<a href="http://www.kumc.edu/ABT/brochure.htm">http://www.kumc.edu/ABT/brochure.htm</a>
Diplomate of the American College of Laboratory Animal Medicine	American College of Laboratory Animal Medicine (ACLAM)	<a href="http://www.aclam.org/">http://www.aclam.org/</a>
Diplomate of the American College of Veterinary Microbiologists	American College of Veterinary Microbiologists (ACVM)	<a href="http://cem.vet.utk.edu/acvm.html">http://cem.vet.utk.edu/acvm.html</a>
Diplomate in Veterinary Pathology of the American College of Veterinary Pathologists	American College of Veterinary Pathologists (ACVP)	<a href="http://www.afip.org/acvp/acvp.html">http://www.afip.org/acvp/acvp.html</a>
Diplomate of the American College of Zoological Medicine	American College of Zoological Medicine (ACZM)	<a href="http://www.geocities.com/zoodvm/aczm/">http://www.geocities.com/zoodvm/aczm/</a>
Certified Hydrographer	American Congress on Surveying and Mapping (ACSM)	<a href="http://www.acsm.net/">http://www.acsm.net/</a>
Certified Drafter (CD)	American Design Drafting Association (ADDA)	<a href="http://www.adda.org/">http://www.adda.org/</a>
Associate Fisheries Scientist (AFS); Certified Fisheries Scientist (CFS)	American Fisheries Society (AFS)	<a href="http://www.fisheries.org/">http://www.fisheries.org/</a>
Certified Gemologist (CG)	American Gem Society (AGS)	<a href="http://www.ags.org/">http://www.ags.org/</a>



Professional Hydrogeologist (PHG) Professional Hydrologist (PH) Professional Hydrologist- Ground Water (PH-GW) Professional Hydrologist-Water Quality (PH- WQ)	American Institute of Hydrology (AIH)	<a href="http://www.bae.umn.edu/aihydro/">http://www.bae.umn.edu/aihydro/</a>
Certified Professional Geologist (CPG)	American Institute of Professional Geologists (AIPG)	<a href="http://www.aipg.org/ScriptContent/Index.cfm">http://www.aipg.org/ScriptContent/Index.cfm</a>
Certified Consulting Meteorologist (CCM)	American Meteorological Society (AMS)	<a href="http://www.ametsoc.org/AMS/">http://www.ametsoc.org/AMS/</a>
Approved Chemist	American Oil Chemists' Society (AOCS)	<a href="http://www.aocs.org/">http://www.aocs.org/</a>
Board Eligible, American Osteopathic Board of Nuclear Medicine Diplomate of the American Osteopathic Board of Nuclear Medicine Diplomate of the American Osteopathic Board of Nuclear Medicine w/Added Qualifications Diplomate of the American Osteopathic Board of Nuclear Medicine w/Added Qualifications in Nuclear Cardiology Diplomate of the American Osteopathic Board of Nuclear Medicine w/Added Qualifications in Nuclear Imaging and Therapy in In Vivo and In Vitro Nuclear Medicine	American Osteopathic Board of Nuclear Medicine	<a href="http://www.aoa-net.org/Certification/nuclear.htm">http://www.aoa-net.org/Certification/nuclear.htm</a>
Board Eligible, American Osteopathic Board of Pathology Diplomate in Anatomic Pathology of the American Osteopathic Board of Pathology Diplomate in Forensic Pathology of the American Osteopathic Board of Pathology Diplomate in Laboratory Medicine of the American Osteopathic Board of Pathology Anatomic Pathology and Laboratory Medicine of American Osteopathic Board of Pathology	American Osteopathic Board of Pathology	<a href="http://www.aoa-net.org/Certification/pathology.htm">http://www.aoa-net.org/Certification/pathology.htm</a>
Aboveground Storage Tank Inspector Certification; Piping Inspector Certification; Pressure Vessel Inspector Certification	American Petroleum Institute (API)	<a href="http://api-ec.api.org/intro/index_noflash.htm">http://api-ec.api.org/intro/index_noflash.htm</a>
Registered Microbiologist (RM); Specialist Microbiologist SM)	American Society for Microbiology (ASM)	<a href="http://www.asmta.org/">http://www.asmta.org/</a>
Nondestructive Testing Level III	American Society for Nondestructive Testing (ASNT)	<a href="http://www.asnt.org/">http://www.asnt.org/</a>
Certified Mapping Scientist -GIS/LIS; Certified Mapping Scientist-Remote Sensing; Certified Photogrammetrist	American Society for Photogrammetry and Remote Sensing (ASPRS)	<a href="http://www.asprs.org/">http://www.asprs.org/</a>
Mechanical Inspector Quality Auditor Quality Engineer Quality Manager Quality Technician Software Quality Engineer	American Society for Quality / ASQ	<a href="http://www.asq.org/">http://www.asq.org/</a>

Certified Mechanical Inspector (CMI); Certified Quality Auditor (CQA) Certified Quality Engineer (CQE) Certified Quality Manager (CQM) Certified Quality Technician (CQT) Certified Reliability Engineer (CRE) Certified Software Quality Engineer (CSQE)	American Society for Quality Control (ASQC) Now the American Society for Quality (ASQ)	<a href="http://www.asq.org/">http://www.asq.org/</a>
	American Society of Mechanical Engineers (ASME)	<a href="http://www.asme.org/">http://www.asme.org/</a>
Petroleum Operations Engineer (POE)	American Society of Petroleum Operations Engineers (ASPOE)	
Certified in Plumbing Engineering (CIPE)	American Society of Plumbing Engineers (ASPE)	<a href="http://www.aspe.org/">http://www.aspe.org/</a>
Certified Cogeneration Professional (CCP) Certified Demand-Side Management Professional (CDSM) Certified Energy Manager (CEM) Certified Energy Procurer (CEP) Certified Indoor Air Quality Professional (CIAQP) Certified Lighting Efficiency Professional	Association of Energy Engineers (AEE)	<a href="http://www.aeecenter.org/">http://www.aeecenter.org/</a>
Certified Ground Water Professional (CGWP)	Association of Ground Water Scientists and Engineers (AGWSE)	<a href="http://www.ngwa.org/membership/agwse.html">http://www.ngwa.org/membership/agwse.html</a>
Registered Polysomnographic Technologist (RPSGT)	Association of Polysomnographic Technologists (APT)	<a href="http://www.aptweb.org/">http://www.aptweb.org/</a>
Registered Biological Photographer (RBP)	Biological Photographic Association (BPA)	<a href="http://www.tmc.edu/bca-news/">http://www.tmc.edu/bca-news/</a>
Associate Ergonomics Professional (AEP) Associate Human Factors Professional (AHEP) Certified Human Factors Professional (CHFP) Certified Professional Ergonomist (CPE)	Board of Certification in Professional Ergonomics (BCPE)	<a href="http://www.bcpe.org/">http://www.bcpe.org/</a>
Diplomate in Diagnostic Radiology of the Board of Certification in Radiology Diplomate in Radiation Oncology of the Board of Certification in Radiology	Board of Certification in Radiology (BCR)	<a href="http://www.aoa-net.org/Certification/radiology.htm">http://www.aoa-net.org/Certification/radiology.htm</a>
Certified Product Safety Manager, Associate Level (CPSM) Certified Products Safety Manager, Executive Level (CPSM) Certified Product Safety Manager, Senior Level (CPSM)	Board of Certified Product Safety Management (BCPSM)	
Certified Occupational Health and Safety Technologist (OHST)	Board of Certified Safety Professionals / BCSP	<a href="http://www.bcsp.org/">http://www.bcsp.org/</a>
Registered Kinesiologist	Board of Registry for Kinesiotherapy	<a href="http://www.caahep.org/ahc/kt.htm">http://www.caahep.org/ahc/kt.htm</a>
Certified Customer Service Specialist (CSS) Certified Electronics Technician, Associate Level Certified Electronics Technician, Journeyman Level Certified Electronics Technician, Master Level Certified Electronics Technician, Senior Level Certified Satellite Installer (CSI)	Electronics Technician Association, International (ETA-I)	<a href="http://www.eta-sda.com/">http://www.eta-sda.com/</a>

Board Certified Entomologist (BCE)	Entomological Society of America (ESA)	<a href="http://www.entsoc.org/">http://www.entsoc.org/</a>
Fluid Power Engineer Fluid Power Mechanic Fluid Power Specialist Fluid Power Technician Hydraulic Specialist Hydraulic Technician Industrial Hydraulic Mechanic Mobile Hydraulic Mechanic Pneumatic Mechanic Pneumatic Technician Pneumatic Speciali	Fluid Power Society / FPS	<a href="http://www.ifps.org/">http://www.ifps.org/</a>
Apprentice Installer; Installer; Master Installer; Systems Design	Institute for Sustainable Power (ISP)	<a href="http://www.ispq.org/">http://www.ispq.org/</a>
Qualified Environmental Professional (QEP)	Institute of Professional Environmental Practice / IPEP	<a href="http://www.ipep.org/">http://www.ipep.org/</a>
Equipment Control Systems Technicians	Instrument Society of America	<a href="http://www.isa.org/">http://www.isa.org/</a>
Certified Knowledge Engineer (CKE)	International Association of Knowledge Engineers (IAKE)	
Certified Biomedical Equipment Technician (CBET) Certified Laboratory Equipment Specialist (CLES) Certified Radiology Equipment Specialist (CRES)	Association for the Advancement of Medical Instrumentation (AAMI)	<a href="http://www.aami.org/">http://www.aami.org/</a>
NETA Certified Test Technician	International Electrical Testing Association (NETA)	<a href="http://www.netaworld.org/">http://www.netaworld.org/</a>
General Supervisor (Gsup) Physician Office Laboratory Technician (POLT) Registered Laboratory Technician (RLT) Registered Medical Technologist (RMT)	American Association of Bioanalysts (AAB)	<a href="http://www.aab.org/">http://www.aab.org/</a>
Certified Control Systems Technician, Level I (CCST) Certified Control Systems Technician, Level II (CCST) Certified Control Systems Technician, Level III (CCST)	ISA / International Society for Measurement and Control	<a href="http://www.isa.org/">http://www.isa.org/</a>
Professional Certified in Materials Handling (PCMH) Professional Certified in Materials Management (PCMM)	Materials Handling and Management Society (MHMS)	<a href="http://www.mhia.org/PS/PS_MHMS_Home.cfm">http://www.mhia.org/PS/PS_MHMS_Home.cfm</a>
Certified Electron Microscopy Technologist	Microscopy Society of America (MSA)	<a href="http://www.msa.microscopy.com/">http://www.msa.microscopy.com/</a>
Certification in Ergonomics Certification in MTM-1 Certification in MTM-1(120) Certification in MTM-UAS-A Certification in MTM-UAB-B	MTM Association for Standards and Research (MTM)	<a href="http://www.mtm.org/public/pages/index.cfm?pageid=1">http://www.mtm.org/public/pages/index.cfm?pageid=1</a>

Cathodic Protection Specialist Chemical Treatments Specialist Corrosion Specialist Corrosion Specialist, G Corrosion Specialist, P Corrosion Technician Corrosion Technologist Mate Protective Coatings Specialist Senior Corrosion Technologist materials Selection/Design Specialist	NACE International	<a href="http://www.nace.org/">http://www.nace.org/</a>
	NATE / North American Technician Excellence, Inc.	8201 Greensboro Drive, Suite 300, McLean, Virginia 22102 Telephone: (703) 610-9033 Fax: (703) 610-9005
Certified Industrial Technologist (CIT) Certified Senior Industrial Technologist (CSIT)	National Association of Industrial Technology / NAIT	<a href="http://www.nait.org/main.html">http://www.nait.org/main.html</a>
Electromagnetic Compatibility Engineer Electromagnetic Compatibility Technicians Electrostatic Discharge Control Engineer Electrostatic Discharge Technician Radio and Communications Engineer, Class I Radio and Communications Engineer, Class III Radio and Telecommunications Engineer, Class I Radio and Telecommunications Engineer, Class II Radio and Telecommunications Engineer, Class III Radio and Communications Engineer, Class II	National Association of Radio and Telecommunications Engineers (NARTE)	<a href="http://www.narte.org/">http://www.narte.org/</a>
Certified Professional Chemical Engineer (CPChE) Certified Professional Chemist (CPC)	National Certification Commission in Chemistry and Chemical Engineering (NCCCCE)	<a href="http://www.theaic.org/cert.htm">http://www.theaic.org/cert.htm</a>
Certified Echocardiographic Technologist (CET) Professional Ultrasound Technologist	National Foundation for Non-Invasive Diagnostics (NFNID)	
Associate Engineering Technician (AET) Associate Engineering Technologist (ACT) Certified Engineering Technologist (CT) Engineering Technician (ET) Senior Engineering Technician (SET) Technician Trainee (TT)	National Institute for Certification in Engineering Technologies / NICET	<a href="http://www.nicet.org/">http://www.nicet.org/</a>
Clinical Chemist (CCT) Clinical Chemistry Technologist (CCT) Toxicological Chemist	National Registry in Clinical Chemistry (NRCC)	<a href="http://members.aol.com/nrcc6/nrcc.htm">http://members.aol.com/nrcc6/nrcc.htm</a>
Certified Nuclear Medicine Technologist (CNMT)	Nuclear Medicine Technology Certification Board /NMTCB	<a href="http://www.nmtcb.org/">http://www.nmtcb.org/</a>
Project Management Professional (PMP)	Project Management Institute (PMI)	<a href="http://www.pmi.org/">http://www.pmi.org/</a>
Certified Research Administrator (CRA)	Research Administration Certification Council (RACC)	<a href="http://infoserv.rttonet.psu.edu/spa/cra.htm">http://infoserv.rttonet.psu.edu/spa/cra.htm</a>
	Robotics International Society of Manufacturing Engineers	

Certified Manufacturing Engineer Certified Manufacturing Technologist Certified Enterprise Integrator	Society of Manufacturing Engineers / SME	<a href="http://www.sme.org/">http://www.sme.org/</a>
Certified Manufacturing Engineer Certified Manufacturing Technologist Certified Enterprise Integrator	Certified Plastics Technologist	

### Postsecondary *Degree Options*

Title/Type/Descriptor of Degree Program	Degree Conferring Organization	Source for Contact Information
Anatomy	Colleges and Universities	<a href="http://www.careertools.org">www.careertools.org</a> Search under the topic <i>Training &amp; Education</i>
Biochemistry	Colleges and Universities	
Biology, General	Colleges and Universities	
Biophysics	Colleges and Universities	<a href="http://www.careertools.org">www.careertools.org</a> Search under the topic <i>Training &amp; Education</i>
Botany	Colleges and Universities	
Cell Biology	Colleges and Universities	
Ecology	Colleges and Universities	
Entomology	Colleges and Universities	
Human Marine/Aquatic Biology & Animal Physiology	Colleges and Universities	
Microbiology/Bacteriology	Colleges and Universities	
Molecular Biology	Colleges and Universities	
Neuroscience	Colleges and Universities	
Toxicology	Colleges and Universities	
Virology	Colleges and Universities	
Zoology, General	Colleges and Universities	
Polymer/Plastics Engineering	Colleges and Universities	
Engineering, General	Colleges and Universities	
Aerospace, Aeronautical & Astronautical Engineering	Colleges and Universities	
Agricultural Engineering	Colleges and Universities	
Architectural Engineering	Colleges and Universities	
Bioengineering & Biomedical Engineering	Colleges and Universities	
Ceramic Sciences & Engineering	Colleges and Universities	
Chemical Engineering	Colleges and Universities	
Civil Engineering	Colleges and Universities	
Computer Engineering	Colleges and Universities	
Electrical, Electronics & Communications Engineering	Colleges and Universities	
Engineering Mechanics	Colleges and Universities	
Engineering Physics	Colleges and Universities	
Engineering Science	Colleges and Universities	
Environmental /Environmental Health Engineering	Colleges and Universities	
Geological Engineering	Colleges and Universities	

Geophysical Engineering	Colleges and Universities	
Industrial/Manufacturing Engineering	Colleges and Universities	
Materials Mechanical Engineering	Colleges and Universities	
Metallurgical Engineering	Colleges and Universities	
Mining & Mineral Engineering	Colleges and Universities	
Naval Architecture & Marine Engineering	Colleges and Universities	
Nuclear Engineering	Colleges and Universities	
Ocean Engineering	Colleges and Universities	
Petroleum Engineering	Colleges and Universities	
Systems Engineering	Colleges and Universities	
Textile Sciences & Engineering	Colleges and Universities	
Engineering Design	Colleges and Universities	
Engineering/Industrial Management	Colleges and Universities	
Engineering Materials Science	Colleges and Universities	
Aeronautical & Aerospace Engineering Technology/Technician	Colleges and Universities	
Architectural Engineering Technology/Technician	Colleges and Universities	
Biomedical Engineering-Related Technology/Technician	Colleges and Universities	
Civil Engineering/Civil Technology/Technician	Colleges and Universities	
Construction/Building Technology	Colleges and Universities	
Electrical, Electronic & Comm Engineering Technology/Technician	Colleges and Universities	
Electromechanical Technology/Technician	Colleges and Universities	
Engineering Technology/Technician, General	Colleges and Universities	
Environmental & Pollution Control Technology/Technician	Colleges and Universities	<b><a href="http://www.careertools.org">www.careertools.org</a> Search under the topic <i>Training &amp; Education</i></b>
Heating, Air Conditioning & Refrigeration Technologies/Technician	Colleges and Universities	
Industrial/Manufacturing Technology/Technician	Colleges and Universities	
Instrumentation Technology/Technician	Colleges and Universities	
Laser & Optical Technology/Technician	Colleges and Universities	
Mining Occupational Safety & Health Technology/Technician & Petroleum Technologies	Colleges and Universities	
Quality Control Technology/Technician	Colleges and Universities	
Robotics Technology/Technician	Colleges and Universities	
Solar Technology/Technician	Colleges and Universities	
Surveying	Colleges and Universities	

## **Section VII – Validation Overview/ Results**



## VALIDATION REPORT

### *Background*

Cluster advisory committees made up of business and industry representatives, secondary/postsecondary educators, associations/organizations, government agencies and other stakeholders developed and conducted an initial review of the knowledge and skills statements. From July 15, 2002 through August 15, 2002, the States' Career Clusters Initiative conducted a national online validation of the knowledge and skill statements. The validation rated the degree of commonality and importance of each statement (see tables below). Each Cluster Committee reviewed the knowledge and skill ratings as well as any written responses to a particular statement. Likewise, each committee determined the appropriate action to take with regard to this data.

### **Cluster Question:**

Question #1 : Is the knowledge and skill statement common to all <a href="#">occupations</a> across the cluster ?	Question #2 : Is the knowledge and skill statement important to workplace success and/or further education ?
-------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------

### **Pathway Question:**

Question #1 : Is the knowledge and skill statement common to all <a href="#">occupations</a> across the pathway ?	Question #2 : Is the knowledge and skill statement important to workplace success and/or further education ?
-------------------------------------------------------------------------------------------------------------------	--------------------------------------------------------------------------------------------------------------

### **Rating Key:**

<b>Question #1:</b> <input type="checkbox"/> Don't Know -N/A <input type="checkbox"/> Common to a few (25% or less) <input type="checkbox"/> Common to some (25 - 50%) <input type="checkbox"/> Common to many (51 - 75%) <input type="checkbox"/> Common to most (76 - 100%)	<b>Question #2:</b> <input type="checkbox"/> Don't Know -N/A <input type="checkbox"/> Not important <input type="checkbox"/> Somewhat important <input type="checkbox"/> Important <input type="checkbox"/> Critical
----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------



### *General Validation Statistics for the Eleven Clusters*

Total Number of Respondents: 1133 completed profiles, 828 completed validation

Number of States/Others Represented: All 50 states/5 other

Overall profiles of respondents:

#### Organization Type

Business/Industry – 17.3 %

State Agency – 13.4 %

Federal Agency – 2.4 %

Association – 6.2 %

Secondary Education – 36.5 %

Postsecondary Education – 14.1 %

Other – 10.1 %

Average # of Years of Experience: 18.3 years

### *Specific Cluster Validation Statistics*

Total Number of Respondents: 49

Number of States/Others Represented: 22

Overall profiles of respondents:

#### Organization Type

Business/Industry – 20.4 %

State Agency – 26.5 %

Federal Agency – 0 %

Association – 2.0 %

Secondary Education – 20.4 %

Postsecondary Education – 26.5 %

Other – 4.2 %

Average # of Years of Experience: 18.2 years

# Cluster Responses

Ratings of "Don't Know" are not included in this report.

Question #1: Is the knowledge and skill statement common to all occupations across the cluster?

Question #2: Is the knowledge and skill statement important to workplace success and/or further education?

StatementCode	StatementDescription	# Rsp	Q1 Avg	Q1=1	Q1=2	Q1=3	Q1=4	Q2 Avg	Q2=1	Q2=2	Q2=3	Q2=4
<b>Cluster: Science, Technology, Engineering and Mathematics</b>												
SCC02.01	Demonstrate effective oral, written, and visual communication.	46	3.87	1	0	3	42	3.83	0	0	8	38
SCC04.01	Use information technology to gather, store, apply and communicate data.	46	3.74	0	0	12	34	3.59	0	2	15	29
SCC04.02	Evaluate the different technological tools used to manipulate and model data.	46	3.35	1	2	23	20	3.11	0	5	31	10
SCC06.01	Apply safety practices in your environment.	46	3.59	0	1	17	28	3.50	0	5	13	28
SCC06.02	Develop a broad awareness of safety, health, and environmental hazards.	46	3.43	1	2	19	24	3.22	1	3	27	15
SCC06.03	Engage in continuous improvement of environmental, health and safety practices.	46	3.20	1	7	20	18	3.07	1	8	24	13
SCC07.01	Participate effectively on a team.	46	3.61	0	1	16	29	3.46	0	3	19	24
SCC07.02	Understand how and when to form teams.	46	3.04	2	4	30	10	2.93	0	11	27	8
SCC08.01	Know current ethical and legal standards in the scientific and mathematics as well as the engineering and technology community.	46	3.43	0	6	14	26	3.17	0	9	20	17
SCC09.01	Identify patterns, relations, and functions of an organization or a workplace.	46	2.98	3	8	22	13	2.72	2	16	21	7
SCC09.02	Exhibit continuous improvement for personal and professional growth.	46	3.72	0	1	11	34	3.33	0	5	21	20
SCC09.03	Explore career pathways in science, technology, engineering, and mathematics.	43	3.26	1	8	13	21	2.93	1	11	21	10
<b>Totals:</b>		<b>549</b>	<b>3.43</b>	<b>10</b>	<b>40</b>	<b>200</b>	<b>299</b>	<b>3.24</b>	<b>5</b>	<b>78</b>	<b>247</b>	<b>219</b>

# Pathway Response

Ratings of "Don't Know" are not included in this report.

Question #1: Is the knowledge and skill statement common to all occupations within the pathway?

Question #2: Is the knowledge and skill statement important to workplace success and/or further education?

StatementCode	StatementDescription	# Rsp	Q1 Avg	Q1=1	Q1=2	Q1=3	Q1=4	Q2 Avg	Q2=1	Q2=2	Q2=3	Q2=4
<b>Cluster: Science, Technology, Engineering and Mathematics</b>		<b>Pathway: Engineering and Technology</b>										
SCPA01.01	Apply concepts and processes as defined by the National Council of Teachers of Mathematics in Principles and Standards for School Mathematics.	26	3.15	1	3	13	9	3.12	1	3	14	8
SCPA01.02	Apply concepts and processes as defined by the National Research Council in the National Science Education Standards, and by the American Association for the Advancement of Science in Benchmarks for Science Literacy.	25	3.20	1	4	9	11	3.04	1	5	11	8
SCPA01.03	Apply concepts and processes as defined in the Standards for Technological Literacy: Content for the Study of Technology, and the American Association for the Advancement of Science in Benchmarks for Science Literacy.	26	3.31	0	3	12	11	3.27	0	2	15	9
SCPA04.01	Use information technology applications.	29	3.76	0	1	5	23	3.66	0	0	10	19
SCPA04.02	Manage, develop, and improve Information Technology (IT) tools.	29	2.90	3	6	11	9	2.79	0	11	13	5
SCPA10.01	Apply technological content concepts, and principles.	28	3.57	0	1	10	17	3.54	0	1	11	16
SCPA10.02	Model technical competence.	29	3.72	0	2	4	23	3.66	0	1	8	20
SCPA11.01	Examine elements of the design process.	28	3.21	1	5	9	13	3.25	0	5	11	12
SCPA11.02	Demonstrate and apply the design process.	29	3.14	2	4	11	12	3.21	0	5	13	11
<b>Cluster: Science, Technology, Engineering and Mathematics</b>		<b>Pathway: Science and Math (Investigative, Informational, Educational</b>										
SCPB01.01	Understand how science and mathematics function as an active component of the real world.	25	3.72	0	1	5	19	3.44	0	3	8	14
SCPB01.02	Apply essential concepts and skills for proficiency in science and mathematics in real-world situations.	25	3.84	0	0	4	21	3.84	0	0	4	21

StatementCode	StatementDescription	# Rsp	Q1 Avg	Q1=1	Q1=2	Q1=3	Q1=4	Q2 Avg	Q2=1	Q2=2	Q2=3	Q2=4
SCPB01.03	Assess the impact that science and mathematics has on society.	25	3.16	0	4	13	8	2.84	1	6	14	4
SCPB03.01	Use scientific and mathematical problem-solving skills to produce viable solutions to problems.	25	3.68	0	0	8	17	3.60	0	1	8	16
SCPB03.02	Use critical thinking skills to translate, interpret, and summarize research and statistical data.	25	3.64	0	1	7	17	3.64	0	0	9	16
SCPB10.01	Demonstrate knowledge and application of technical skills needed in a chosen scientific and mathematical field.	25	3.76	0	0	6	19	3.44	0	0	10	14
<b>Totals:</b>		<b>399</b>	<b>3.45</b>	<b>8</b>	<b>35</b>	<b>127</b>	<b>229</b>	<b>3.35</b>	<b>3</b>	<b>43</b>	<b>159</b>	<b>193</b>

## **Section VIII – Assessment Protocol Certification Protocol**

## **Deliverable #7**

### **Title: Protocol for Career Clusters Assessment**

8/5/2002 4:00 PM

#### **Definition of Career Clusters Assessment**

Assessment, within the context of the Career Clusters Initiative, is defined as *a **measurement** of what a learner should know and be able to do*. The academic and technical knowledge and skills common to all occupations and pathways within a single cluster are initially addressed in the Career Clusters Initiative. Each cluster measures or assesses a learner's knowledge and skills related to the cluster.

#### **Purpose of the Protocol for Career Clusters Assessments**

The purpose of this document is to provide:

- Minimum criteria for selecting existing assessment instruments that align to the academic and technical knowledge and skills identified for each cluster.
- Minimum criteria for developing new assessment instruments that align to the academic and technical knowledge and skills identified for each cluster.
- Minimum criteria for validating and determining reliability of assessment instruments.

#### **Functions of Career Clusters Assessment**

Career Cluster Assessment serves to

- *measure* (assess) *student achievement*, both cognitive and performance, in areas of academic and technical knowledge and skills for each cluster
- *provide the basis* for a transportable, industry-endorsed certification.

#### **Operational Guidelines for Career Clusters Assessment**

This protocol includes minimum criteria/expectations career cluster designers need to apply in the selection/development of assessment modalities. Career clusters assessment:

##### **CONTENT**

- measures all 10 Foundation knowledge and skills.
- customizes context of questions and applications to individual clusters.
- reflects a high degree of specificity of measurable knowledge and skills.
- aligns to academic standards.
- connects to post high school standards and competencies.
- is consistent with Perkins data-quality criteria.

##### **FORM**

- combines a minimum of two modalities: cognitive and performance.
- includes an item bank that can accommodate multiple applications.
- reflects quality design and clear formats.

##### **APPLICATIONS AND USES**

- offers diagnostic feedback to the learner.
- provides added value to the user (employer, post high school); not required for employment.
- affords portability of results.
- provides cues for instruction.

**ADMINISTRATION**

- validates identity of test takers through a secure system.
- affords flexible administration, e.g. single assessment per foundation cluster topic or combination of topics.
- provides flexible timing for administration.
- affords no cost or low cost to students.
- includes an affordable, user-friendly process to cover administrative costs.
- reflects an administration process that is as consistent as possible with other career cluster assessments.
- includes an affordable, user-friendly maintenance process.

**VALIDITY AND RELIABILITY**

- uses consistent, reliable, and technically strong elements.
- is recognized by business and industry.
- is recognized by post high school education and training.

## **Deliverable #8**

### **Title: Protocol for Career Clusters Certification**

8/23/2002 2:28 PM

#### **Definition of Career Clusters Certification**

Certification, within the context of the States' Career Clusters Initiative, *documents* learner achievement of the academic and technical knowledge and skills common to all pathways and occupations within a cluster. It is based on valid and reliable assessments. A certificate is recognized by employers, secondary education, and post high school education as "value added to the admissions process to further education, immediate employment process, and/or to employment advancement".

#### **Purposes of the Protocol for Careers Cluster Certification**

The purposes of this document are to provide:

- Minimum criteria for selecting existing certification programs that align to the academic and technical knowledge and skills identified for each cluster.
- Minimum criteria for developing new certification programs that align to the academic and technical knowledge and skills identified for each cluster.
- Minimum criteria for determining the value of a certification program.

#### **Functions of Career Clusters Certification**

Career Cluster Certification serves to provide a consistent, transportable method of documenting learner achievement of a Career Cluster's validated academic and technical knowledge and skills. The system is based on valid and reliable assessments.

#### **Operational Guidelines for Career Clusters Certification**

This protocol includes minimum criteria/expectations career cluster designers need to apply in the selection/development of certification processes. Career clusters certification:

- Defines the purpose and scope of the certificate.
- Bases issue of the certificate on assessed learner proficiencies and competencies related to a Career Cluster's validated academic and technical knowledge and skills.
- Requires learner to meet the assessment benchmark identified.
- Informs the public concerning the knowledge and skills of the certificate holder.
- Indicates date of issue on the certificate.
- Issues certificate from the State (State Director of Career-Technical Education or appropriate designee) if the issuing organization is a secondary or post secondary education institution.
- Issues certificate from the CEO (or an appropriate designee) of an issuing professional organization/agency/institution/company.
- Requires issuing organization to maintain a database (state and/or national) of certificate holders based on the respective term of renewal.





National Association of State Directors  
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